Nuclear Operating Company
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April 20, 2017
NOC-AE-17003469
10 CFR 50.12
10 CFR 50.90

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Response to ACRS Subcommittee Question re Containment Spray Flow Considered for Single Train Case in Supplement 3 to STP Risk-Informed GSI-191 Licensing Application
(TAC NOs MF2400 and MF2401)

Reference: Letter, James Connolly, STPNOC, to NRC Document Control Desk, "Supplement 3 to Revised STP Pilot Submittal and Requests for Exemptions and License Amendment for Risk-Informed Approach to Resolving Generic Safety Issue (GSI)-191," October 20, 2016, NOC-AE-16003401, ML16302A015

This letter responds to a question asked of STPNOC in the April 5, 2017, joint meeting of the Advisory Committee on Reactor Safeguards (ACRS) Thermal-hydraulic Phenomena Subcommittee and the Reliability and PRA Subcommittee.

There are no commitments in this submittal.

If there are any questions, please contact Mr. Drew Richards at 361-972-7666 or me at 361-972-7344.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: April 20, 2017

James Connolly
James Connolly
Site Vice President

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Attachment: Response to ACRS Subcommittee Question

STI 34483599

cc:

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Attachment

Response to ACRS Subcommittee Question

ACRS Subcommittee Question:

For single train operation, what is the net positive suction head (NPSH) margin with full flow from the Containment Spray System (CSS) and Emergency Core Cooling System (ECCS) pumps?

STPNOC Response:

For two train operation the total strainer flow per sump is 7020 gpm (Low Head Safety Injection (LHSI) pump 2800 gpm; High Head Safety Injection (HHSI) pump 1620 gpm; and CSS pump 2600 gpm). The July 2008 strainer head loss test with all deterministic debris and chemical effects was based on a total flow of 7020 gpm per sump. For single-train operation, the CSS pump flow is higher, which yields a total strainer flow for the sump of 7220 gpm (LHSI pump 2800 gpm; HHSI pump 1620 gpm; and CSS pump 2800 gpm).

The table below is from Supplement 2, August 2015 (ML15246A126) and shows results for the two-train case. A sump temperature of 212°F yields the smallest difference between NPSH Margin and Total Strainer Head Loss. The bolded row below has been added for the single train case at 212°F with deterministic debris amounts and chemical effects and it shows that there is not adequate NPSH margin (i.e., NPSH margin is less than total strainer head loss)[1].

Containment Spray Pump				
Sump Temperature, °F	NPSH Required, ft	NPSH Available, ft	NPSH Margin, ft	Total Strainer Head Loss in 2008 test, ft
267 Start of Recirculation 24 minutes	1.4	7.2	5.8	3.8
226 Hot Leg Switchover 5.5 hours	1.4	7.2	5.8	4.6
215	1.4	7.2	5.8	5.0
212	1.4	7.2	5.8	5.1
Single Train 212	**1.6**	**6.6**	**5.0**	**5.4**

As shown in Supplement 3, October 2016 (ML16302A015, Attachment 1-3, Section 4, Table 7), the total success frequency given a large loss of coolant accident (LOCA) for single-train operation, based on all pump state configurations with only one LHSI operating, is 1.55E-09 per year. As further explained in detail in (Johnson, 2015), the success frequency is determined using a version of the STP probabilistic risk assessment (PRA) modified to model GSI-191 phenomena and assuming a large LOCA, which is defined as break sizes equivalent to 6" and above. An equivalent break diameter of just 6" would produce significantly less fiber than a 9" break (volume enclosed in the 6" break zone of influence (ZOI) would be approximately 30% of the 9" break ZOI volume), and 9" breaks are the approximate expected minimum size break that would lead to sump plugging for single pump train operable configurations.

[1] STPNOC calculations show that use of more realistic chemical effects and/or sump levels will result in adequate NPSH margin for the single-train case.

The effect on $\widehat{\Phi}$ for different, more limiting bounds on single-train failure criteria would be calculated using (5a) - (5c) in Supplement 3, Attachment 1-3 as summarized in the table below. The table shows the effect of assuming all single-train cases fail at different equivalent circular break sizes at 6" and 7" for the continuum model and geometric mean aggregation. Values for the new $\widehat{\Phi}$ and the change in $\widehat{\Phi}$ from the value given in Supplement 3, Attachment 1-3 (1.5E-07) are shown. Because the conditional probability of the Case 2 (i.e., single train of LHSI) configuration is so small, an extremely small break size must be assumed for Case 2 to be visible in the final result (5c).

Any single-train scenarios with a configuration different than one with exactly one HHSI, one LHSI, and one CSS pump operating on a single strainer will be success. Approximately 30% of the single-train cases correspond to this configuration. That is, the first set of results shown in the table corresponds to any scenario with just one LHSI pump operating. The scenario frequency for Case 2 (f_1) in the STP application conservatively represents these scenarios. A more realistic value for (f_1) where only one HHSI, only one LHSI, and only one CSS pump in the same train are operating is 4.85E-10.

Summary of break size assumed for all Case 2 (single-train) scenarios with the NUREG 1829 mean value (Case 2 GM) and the change from the values for $\widehat{\Phi}$ and LERF given in Supplement 3

Break	Case 2 GM (NUREG 1829 Frequency)	new $\widehat{\Phi}$	Change in $\widehat{\Phi}$	New LERF	Change (LERF)
6"	4.18E-06 (per year) *interpolated*	1.52E-07	1.50E-09	3.79E-10	3.76E-12
7"	1.51E-07 (per year)	1.51E-07	5.4E-10	3.76E-10	1.35E-12
	Use only failure cases (HHSI, LHSI, and CSS on single train)				
6"	4.18E-06 (per year) *interpolated*	1.50E-07	4.70E-10	3.76E-10	1.18E-12
7"	1.60E-06 (per year)	1.50E-07	1.69E-10	3.75E-10	4.23E-13

As shown, the maximum contribution to large early release frequency (LERF) from single train configurations for all large LOCAs (LOCA >6") would be the product of 1.52E-07 and 2.5E-03 (the conditional probability of large early release from Supplement 3, Attachment 1-3, Table 8), which is approximately 3.8E-10. This would increase the calculated ΔLERF provided in Supplement 3 (3.75E-10) by approximately 3.76E-12. Therefore, all large LOCA single-train cases could be relegated to failure with effectively no change in the results reported in the STP application. If a more realistic value for single-train frequency is used, the small changes calculated for the conservative single-train configuration assumption could be further reduced (by about 30%).

Reference

Johnson, D. (2015, June). PRA Calculations in Support of RoverD White Paper Development. Letter Report STP-338116-O-02, STP STI 34176256, ABSG Consulting Inc., Irvine, CA 92602.